REMARKS

Claims 60-80 are pending, with claims 60, 66, 72, 79, and 80 being in independent form. Claims 1-59 are canceled without prejudice or disclaimer.

At the outset, Applicants wish to thank the Examiner for the courtesies extended to Applicants' representative during a personal interview conducted October 2, 2003. During the interview, a discussion was had concerning the distinctions between the pre-formed nanostructure containing material recited by the presently claimed invention, and the aligned in situ form nanostructure material described in Hsu, as well as the nanoparticles described by Gärtner.

In the final Office Action, claims 1, 5-8, 10-11, 22, 43, 52-53, 55, and 59 were rejected for anticipation and claim 44 for obviousness by U.S. Patent No. 6,448,701 to Hsu ("Hsu"). Claims 1-9, 12-21, 23-26, 39-42, 45-54, and 56-59 were rejected for obviousness over U.S. Patent No. 5,866,975 to Gärtner et al. ("Gärtner"). Claims 27-31 were rejected obviousness over U.S. Patent No. 4,707,762 to Yapoujin ("Yapoujin") in view of Gärtner. Claims 32-33 and 35 were rejected for obviousness over U.S. Patent No. 5,557,250 to Debbaut et al. ("Debbaut") in view of Gärtner. Claims 34 and 36 were for obviousness over Debbaut and Gärtner in view of U.S. Patent No. 5,557,672 to Perry et al. ("Perry"). Claims 37 and 38 were rejected for obviousness over Debbaut and Gärtner in view of U.S. Patent No. 5,841,836 to Dunn et al. ("Dunn"). In addition, the drawings were objected to for not showing all of features recited in claims 34 and 36-38.

The rejections raised in the final Office Action, as well as the objections made to the drawings, are rendered moot by the entry of this Amendment. Nevertheless, independent claims 60, 66, and 72 are directed to subject matter that is substantially similar to that defined by canceled claims 15, 39, and 42, respectively. Accordingly, Applicants are presenting arguments for the patentability of the pending claims in light of the prosecution history of the application.

For example, the independent claims 60, 66, and 72 are directed to gas discharge and lighting devices and a method of forming the same, that recite, among other things, "at least one electrode . . . comprising at least one of nanotubes and nanorods". The final Action states that Gärtner discloses an electric discharge tube or discharge lamp having an electrode 22 that includes a "nano-structure containing material" 26. The final Action admits that Gärtner does not describe that the "nano-

structure containing material" 26 comprises at least one of nanotubes and nanorods. Nevertheless, the final Action asserts that it was well known in the art that at the time of this invention that such "nano-structure containing material" included nanotubes and nanorods, and that it would have been obvious to include such structures in Gärtner's "nano-structure containing material" to reach the claimed invention. Applicants respectfully disagree for following reasons.

First, the final Action over-broadly construes Gärtner's layer 26 as a "nano-structure containing material" using language from Applicants' own specification, instead of determining the plain-meaning of the terms used by Gärtner to describe the layer as the law requires. Throughout the cited document, Gärtner describes the layer 26 as "a top coating of ultrafine particles having a nanostructure". A "particle" is defined as "a relatively small or the smallest discrete portion or amount of something". Merriam-Webster Dictionary (10th Edition).

The final Action first errs by ignoring the plain-meaning of term the "particles" in construing Gärtner's layer 26 as a "nano-structure containing layer" that can include nanotubes and nanorods. In contrast to the meaning of a "particle", a "tube" is defined as "any of the various usually cylindrical structures or devices, such as a hollow elongated cylinder". Id. Similarly, a rod is defined as "a thin straight piece or bar of material". American Heritage Dictionary (4th Edition). Nanotubes and nanorods are tubes and rods of material that are nanometer-sized in at least one direction. For example, a single-walled carbon nanotube can have a diameter of 1-2 nm, while having a length of nearly a micron.

Moreover, Gärtner describes at col. 6, ll. 41-45, that "the tungsten content of the top coating consists of ultrafine particles having a diameter of 1 to 50 nm which are deposited in a nano-structured layer", and that "the other two components are also deposited as ultrafine particles and are situated partly between and partly on tungsten particles". Gärtner's closed use of the term "particles", the dimension of which are defined only by a diameter, further precludes construing the top coating layer 26 to include nanotubes or nanorods. Thus, Gärtner's "ultrafine particles", which by definition are the smallest discrete portion or amount of something, cannot be construed so broadly to encompass high-aspect-ratio (length/width) nanotubes and nanorods recited in the pending claims as the Action asserts.

The error in construing Gärtner's "ultrafine particles" is compounded in the final Action by relying on a statement in Applicant's own specification to support the rejection of claims 15, 39, and 42, which states that "examples of [nanostructure-containing materials] include nanoparticles, cage-like fullerene molecules, carbon nanotubes, and silicon nanorods".

First, for reasons stated above, the assertion is not based upon the teachings of Gärtner, but instead is based on an improper hindsight reconstruction of the prior art that benefits from Applicants' own disclosure. Such hindsight construction is improper as a matter of law. Notwithstanding this, Applicants' statement has been misconstrued to support the final Action's assertion that nanoparticles can include carbon nanotubes, and silicon nanorods, when instead the statement clearly indicates that nanoparticles, carbon nanotubes, and silicon nanorods are all distinct examples of the broader category of "nanostructure-containing materials". Thus, the pending claims are believed to patentable over Gärtner for this reason as well.

Not only does Gärtner's use of the term "ultrafine particles" to describe the composition of the layer 26 preclude construing the layer to include nanotubes and nanorods, Gärtner goes so far as to "teach away" or discourage persons skilled in the art from incorporating such structure into the top coating layer 26.

For example, Gärtner describes at col. 3 that "a low-temperature cathode in accordance with the invention comprises . . . a high density of "crystallite microtips" made from ultrafine particles". Col. 3, ll. 1-13. Also, claim 1 recites " an upper coating comprising crystallite microtips of ultrafine particles having a nanostructure". Gärtner further describes that prior-art microtip emitter cathodes have the drawback of the burning-out of single microtips, but that the small radius of curvature of the emitting crystallite microtips made from the ultrafine particles precludes burning out of the microtips.

Accordingly, Gärtner describes the use of ultrafine particles having nanostructure to form a layer of much larger microtip emitters. The microtip emitters are designed to emit electrons released from emission material layers, such as the tungsten metal layer 22 and the substrate dispensing layer 24, including oxidics of Barium, shown in FIG. 2. Persons skilled in the art at the time of this invention would not have been motivated to replace Gärtner's "ultrafine particles" with nanotubes and nanorods to form microtip emitters as the final Action suggests. First, in the absence

of any suggestion in Gärtner, one would have faced a serious engineering problem to form microtips having a small radius of curvature from high-aspect-ratio nanostructures, such as nanotubes and nanorods, that naturally would have had a low probability of success without substantial experimentation and effort. Moreover, the superior electron field emission properties of nanotubes and nanorods discovered by Applicants yield unexpected results that render most, if not all, of the teachings of Gärtner unnecessary. Thus, the pending claims are believed to patentable over Gärtner for this reason as well.

In contrast to the above, the final Action asserts that "Applicant's specific choice of nanotube or nanorod does not solve any of the stated problems or yield any unexpected result that is not within the scope of the teachings applied", and concludes that "it is considered to be a matter of choice, which a person of ordinary skill in the art would have found obvious to select one of the nanostructure containing materials such as a nanotube or nanorod". Applicants respectfully disagree.

Contrary to the unsupported assumptions upon which the grounds for rejection are based, the choice of a nanotube or nanorod type nanostructure over microtips formed from ultrafine particles having a nanostructure does in fact impart specific structural differences, and technical advantages, to the presently claimed invention.

For example, when considering the property of electron field emissions, nanotubes and nanorods provide superior emission performance and capabilities when compared with nanoparticles, as well as microtips formed from such nanoparticles. As discussed above, the higher aspect ratio of nanotubes and nanorods provide enhanced emission properties as compared with nanoparticle-based microtip emitters of the type described by Gärtner. The difference in emission properties can be seen, for example, by comparing table 1 contained in the Gao et al. article cited concurrently herewith, with FIG. 1 of Gärtner. Contrary to the assertion in the final Action, the selection of nanorods and/or nanotubes is simply not a "matter of choice" as contended. Accordingly, the pending claims are considerable allowable over the cited documents for this reason as well.

In addition to the above, the remaining dependent claims recite additional features not described or suggested by the documents made of record. For example, claim 61 defines that the electrode comprises carbon nanotubes. As discussed above, Gärtner does not describe or suggest the use of nanotubes, much less the use carbon nanotubes. Although Hsu describes an arrangement in which groups of nanotubes form emitter cathodes, the document is not prior art as evidenced by the Declaration under 37 C.F.R. § 1.131 attached herewith.

The cited documents also fail to describe or suggest a gas discharge or lighting device, or a method of forming the same, wherein the electrode comprises pre-formed carbon nanotubes deposited after formation on at least a portion of a surface of the electrode. In the final Action, the Examiner asserted that the "recitation of 'pre-formed nano-structure' simply recites the method of forming nano-structure, however, the method of forming the device is not germane to the issue of patentability of the device itself . . . [and] has not been given patentable weight". Applicants respectfully disagree for the following reasons.

The limitation "pre-formed carbon nanotubes" is not simply a process limitation as alleged. Rather, it imparts a structural connotation which distinguishes the present invention as defined by claims 60 and 66 from coatings formed in situ that include aligned nanostructures, e.g., as described in Hsu. As illustrated in Attachment A, a layer or coating containing "pre-formed carbon nanotubes" is quite clearly structurally distinct from a coating or layer formed by growing aligned nanostructures in situ, e.g. as described in Hsu.

Moreover, it is noted that the reviewing authorities have held that terms such as "intermixed," "ground in place," "press fitted," "etched," and "welded" are to be construed as structural, rather than process limitations. Similarly, when the phase "pre-formed carbon nanotubes" is properly considered in the context of the disclosure and claims as a whole, it too is a structural limitation that quite clearly distinguishes it from the teachings of the applied prior art. See, e.g., In re Garnero, 412F.2d 276, 16 U.S.P.Q. 221, 223 (C.C.P.A. 1969).

With regard to method claim 72, which recites, among other things, "forming an emission material comprising at least one of nanotubes and nanorods, and depositing the emission material after formation on at least a portion of a surface of the electrode", this claim can neither be anticipated by nor obviousness in view of a

process of growing a layer of aligned nanostructures on an electrode in situ, such as Hsu's in situ CVD growth process.

The cited documents also fail to describe or suggest a gas discharge or lighting device, or a method of forming the same, wherein the electrode comprises a substrate, carbon nanotubes, and an adhesion promoting material to promote adhesion of the carbon nanotubes to the substrate. The final Action asserts that Gärtner's substrate layer 24 includes such adhesion promoting material, but the assertion is incorrect for following reasons.

Gärtner describes in the Abstract that the electric discharge tube or lamp can include an optional substrate with a dispenser material. Gärtner further describes that the "substrate 24 . . . may be a porous tungsten layer . . . [that] may comprise rhenium, iridium, osmium, ruthenium, tantalum, molybdenum or scandium oxide", that such "percolation-structured porous layers are produced powder-metallurgically", and that in the pores, "the layers comprise a barium compound as the barium source". Col. 6, ll. 3-10.

Accordingly, persons skilled in the art would understand that Gärtner's substrate 24 does not include an "adhesion promoting material", as asserted in the final Action, but instead is an electron dispensing layer including oxidic compounds of Barium. Moreover, Gärtner does not describe or suggest the use of carbon nanotubes, much less an adhesion promoting material to promote adhesion of carbon nanotubes to a substrate, as the claims require. For the same reason, Gärtner fails to describe or suggest any of an adhesion promoting material comprising a carbon-dissolving material, a carbide-forming material, and a material having a low melting temperature relative to a melting temperature of the substrate and a melting temperature of the carbon nanotubes.

Claims 79 and 80 are directed to an electrode for use in a gas discharge or lighting device, and a method for making the same. These claims recite, with varying scope, some of the novel and inventive features discussed above. Accordingly, these claims are considered to be allowable over the documents made of record for at least the same reasons stated above.

For the foregoing reasons, it is believed this application is in condition for allowance and an early Notice of same is earnestly solicited. If any questions remain, the Examiner is invited to phone the undersigned at the below-listed number.

Respectfully submitted,

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Date of Signing: March 5, 2004